ONTARIO. MINISTRY OF THE ENVIRONMENT

ASPECTS OF WASTE DISPOSAL

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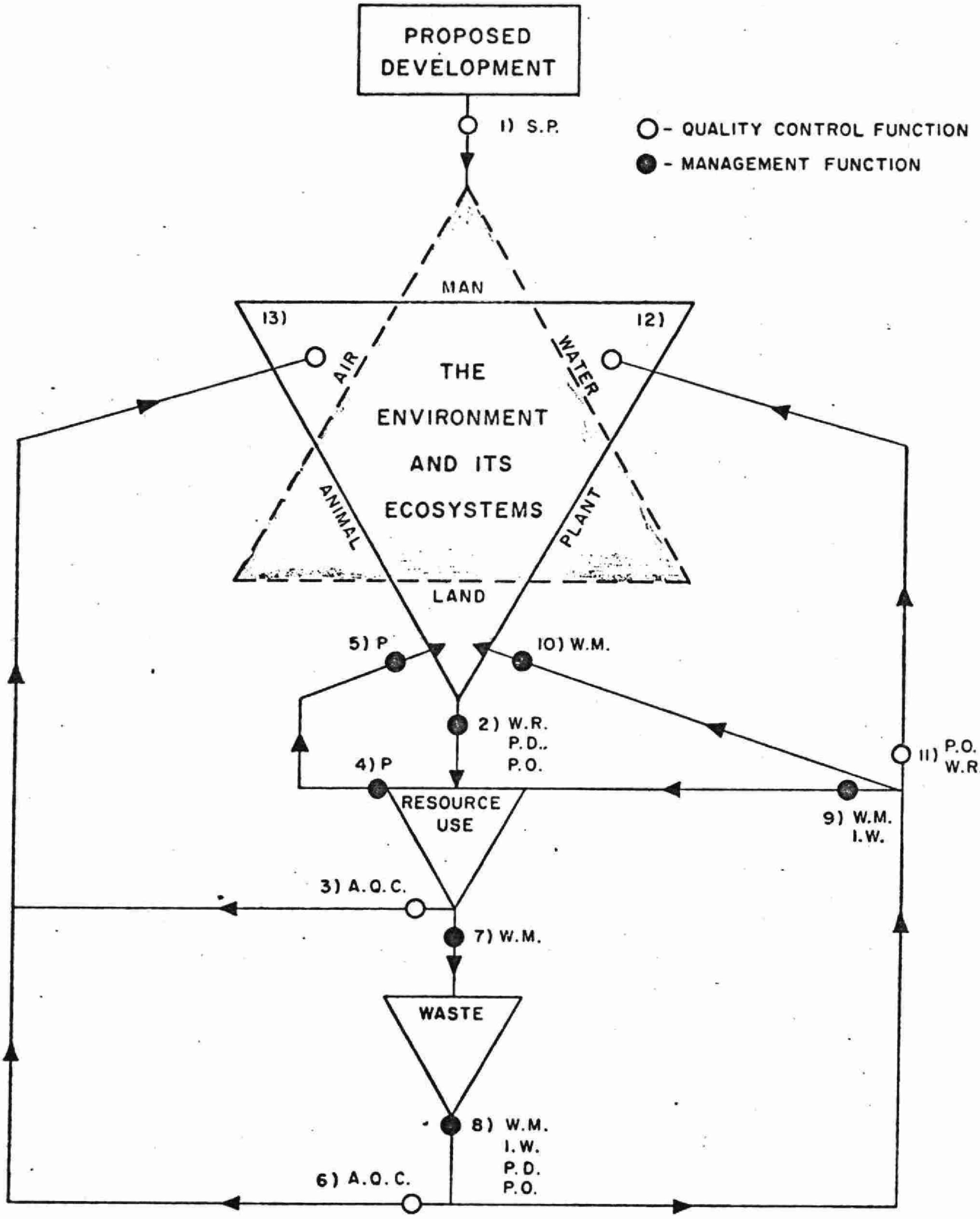

OPERATIONAL FUNCTIONS

It is essential for a full understanding of the problems involved that some fundamental questions should be resolved in advance.

First, what is waste?

One definition is that waste is any material which the owner considers will cost him more to keep than to discard.

This warrants detailed examination.

First, the cost is not necessarily purely monetary; it may compress a penalty in terms of time or effort, or of nuisance or hazard, including health hazards.

Second, these values may, and often do, vary. What is considered waste one day may be prized as a valuable commodity on another.

Third, the decision, conscious or unconscious, whether material is waste or not is an individual one, made by the owner. Until recently, consideration of the cost to the community or the environment of discarding waste was not taken into consideration.

It is also important to note that this definition says nothing about the intrinsic value of the material; only about its value to the owner. I will return to this point, which is of some significance, later.

There is one particular waste which may be considered an exception, since its discard is, largely, involuntary; human bodily wastes, sewage. The hazards resulting from the improper disposal of sewage have been recognized for many years.

Sewage and piped liquid industrial wastes are the major exceptions to the wastes which fall under the jurisdiction of the Waste Management Branch, and are dealt with entirely by the Sanitary Engineering and Industrial Wastes Branches of the Ministry of the Environment, though obviously many problems are of mutual concern.

The wastes for which we are responsible can be separated into six major classifications, with widely differing hazards, problems and solutions, which I will discuss in greater detail at a later stage.

For the moment, it will be sufficient to list them. They are:

1. municipal and industrial solid wastes;
2. liquid industrial wastes;
3. hazardous wastes;
4. agricultural wastes and sewage sludge;
5. abandoned automobiles;
6. litter;

Another question which deserves examination is what is meant by waste management and at this point it is necessary to consider the

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functions of the Ministry as a whole.

Environmental agencies in the past have generally been organized on the basis of the three elements of the environment, air, land and water. It is now being recognized that this is not, in fact, a meaningful basis for organization, and has very little relation to the type of function carried out by the operational units within the organization.

The Ministry of the Environment in Ontario has three basic functions.

1) To protect the quality of the environment. Essentially, this means control of the quality of air and water, by setting standards and ensuring that these standards are maintained.
2) Arising out of this, since quality is generally impaired by the discharge of waste (solid, liquid, gaseous, and including heat, noise and ionising radiation which are related effects) control must be exercised over this discharge, and standards may be laid down on the level of contamination permitted to be discharged into the air, or water.
3) Apart from the control of quality, in the special case of water, the permitted uses may also have to be controlled, and priorities of both quality and quantity allotted to competing uses. In this case quite obviously we are dealing with the management of a resource rather than a quality control function. It is becoming obvious that the Ministry cannot carry out its quality control function unless wastes are also considered a resource which should be managed.

In our view, waste management must include the complete system of storage, collection, transportation, treatment and disposal of waste. The individual elements of the system are intimately interlinked and cannot be dealt with in isolation.

Moreover, the management of waste may well have to take into account some of the questions raised in our definition of waste -- whether a community can afford to accept without question the decision of the owner of the material; or for example whether the original manufacturer of the product should not be responsible for considering in its manufacture the problems which may be involved in its handling and disposal as waste.

I have mentioned that the problem of one waste, sewage, have been recognized for many years. It is only comparatively recently that the public have become aware of the problems involved with other wastes, though they are now making up for lost time. There are a number of reasons for this; but three in particular should be noted.

First, though improper management practices can result in health hazards, these are generally not infectious, not transmissible, and the relation of cause and effect is less obvious.

Second, until comparatively recently, in North America, the urban-rural interface was well defined, and the wastes from a city could be transported beyond its boundaries for disposal in a relatively sparsely populated area. Urbanization has now progressed beyond the boundaries of the cities and may extend for many miles into formerly entirely rural areas. Land area is therefore at a premium and land use planning usually neglects to consider requirements of waste management.

And third, the increase in packaging, and disposable convenience merchandise, compounded by the increase in population and its concentration in urban areas, has vastly increased the volume, variety and hazard of materials which must be handled and disposed of.

Before dealing with the waste classifications and their individual problems, I want to discuss in general terms why we should be concerned about waste management.

There are two relatively distinct problem areas.

One, direct hazards; vectors of disease; air and water pollution; or gas generation for example;

Two, matters of general public health concern in the broader sociological concept of the term.

Usually, direct hazards can be minimized and often eliminated by the proper management of existing practices. New practices, before being introduced, can readily be assessed to ensure that direct hazards will not be introduced.

Waste management legislation in Ontario was designed originally to do this, and is doing it very successfully.

The broader aspect is a very much more complex problem with implications which reach beyond the jurisdiction of any one Government agency, and whose solution may require measures that will be radically different from our present approach.

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Municipal and Industrial Solid Wastes

This classification includes domestic and commercial refuse together with non-hazardous solid industrial waste. It is generally collected and disposed of under the control of the municipality where it is generated.

On the average, this type of waste can be expected to comprise about fifty percent paper and paper products, fifteen to twenty percent organic waste or garbage, between five and ten percent metals and approximately the same quantity of glass, between five and ten percent ashes with the remainder, usually about ten percent, which can only be termed miscellaneous since it may include almost any substance which you care to imagine. The actual compositon varies from day to day, as does the moisture content, and this variety and its heterogeneous character, make it an engineer's nightmare.

The related problems may conveniently be separated into two sections, occupational hazards to workers, and hazards to the general public.

Studies on occupational hazards have generally been related either to municipal refuse collection workers or to industrial-type accidents to workers in the treatment and disposal operations.

Arthritis and cardiovascular diseases appear to be occupational hazards of refuse collectors. A high incidence of muscle and tendons disease, particularly affecting the back, is also prevalent and there is evidence that the same comment may apply to skin diseases. Hernia may also be considered an occupational hazard. Generally sanitation workers have an extremely high injury frequency rate, injuries to the hands being most common.

The use of paper or plastic bags rather than garbage cans will tend to reduce these hazards, but much greater attention must be paid, in the design of collection vehicles and collection system, to the need for a reduction in the manual effort required by collectors.

This is, of course, highly desirable for purely economic reasons. At present, the cost of collection averages three to four times that of disposal and this ratio is unlikely to change unless very much more sophisticated methods of collection and transportation of waste can be introduced.

The one man packer with dual drive, mechanical pick-up and greater use of properly designed containers, both for at-source storage prior to collection, and as simple transfer stations in rural areas, all require intensive investigation.

Vacuum collection is a feasible alternative, though its application will probably be found economic only for high density development, institutions, or areas where special problems of collection exist.

The most promising advance for the near future at least, appears to be rail-haul, particularly since it also offers the possibility of economies in transportation of reclaimed materials.

Turning to disposal, the open dump is the most primitive, and the simplest method for the disposal of municipal waste, and is usually associated with burning of the garbage to reduce its volume and, hopefully, its attractiveness to rodents.

All dumps, whether open burning is practiced or not, provide breeding grounds for rodents, flies and other vectors of disease. In some areas they provide attractive feeding grounds for other animals, particularly bears. The gaseous effluent from burning garbage includes inorganic compounds of sulphur, nitrogen and carbon; prominent organic constituents are aldehydes, organic acids and esters, fats and fatty materials, phenols, and polynuclear hydrocarbons; the particulate matter may be either organic or inorganic, and may be impregnated with acids. While all of these may have some health implications, they are probably small in relation to the discharge of similar elements from other sources. A more specific hazard, which has already resulted in a number of serious accidents, is the loss of visibility due to the smoke from burning dumps being carried across highways.

Since dumps are generally located without any consideration of pollution problems, they are very frequently found adjacent to, or even in water courses, which may be grossly contaminated as a result. Organic material, soluble salts, and alkalis can cause degradation of the water quality.

A more serious problem is the possibility of leaching of these materials into ground water particularly if dug wells are used for water supply in the vicinity. Any hazard which may result will usually be due to soluble salts, since the organics and the associated micro-organisms are virtually eliminated by a comparatively short period of percolation through the soil.

An interesting side light on burning dumps is the fact that tissues of wild rats living in the vicinity of refuse dumps generally have a much higher lead content than those of rats reared in the laboratory, and associated with this higher lead content is a high degree of incidence of nuclear inclusions and carcinomas in the kidneys.

This was ascribed by the investigators to continuous exposure to smoke emanating from the smoldering refuse in the dump in which the rats lived.

Waste management legislation in Ontario does not permit this method for the disposal of waste except for very small communities in remote areas, and even where it is still permitted, certain minimum requirements are laid down to minimize the possibility of health hazard and environmental pollution.

Almost all of the problems discussed above can be virtually eliminated by careful selection of the area in which the site is to be established, and by carrying out the operations using the techniques of sanitary landfill. Essentially, this means that the waste is deposited under controlled conditions with compaction into a cell and covering with at least six inches of compacted earth at regular intervals, preferably daily.

While research is undoubtedly necessary to find quantitative data on the movement of contaminants in leachate through the sub-surface and in the watertable, particularly with regard to reduction of concentration by such mechanisms as ion exchange, adsorption and dilution by dispersion, adequate qualitative data is already available from which the location of the site, to minimize pollution problems, can be made with confidence. The main thrust of our present research programs is to develop more accurate information so that doubtful locations, which are now turned down by the Branch, can be utilized with adequate precautions. The final report on the results of a three year research project at the University of Waterloo will shortly be available.

Two comparatively new developments are now coming into use for the pre-treatment of waste prior to sanitary landfill, principally to reduce costs and the volume of waste; but which also make it easier to minimize nuisances such as blowing papers. Grinding the waste to a common particle size has many advantages and is being closely investigated by the Branch since we feel that it may have wide application throughout Ontario. One such plant is already in use.

Because of these factors, the standards for a landfill site with grinding may be substantially reduced, particularly with regard to the frequency of cover material, which will in due course encourage the use of this method to a greater extent.

The Branch is, at present, funding research by the University of Guelph on the characteristics of ground refuse, particularly upon the possibility of vegetation cover growth directly, and its use without further treatment as a soil conditoner.

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Since grinding is an essential part of most composting and reclamation operations, this aspect will be discussed under these separate headings.

Packing and baling involves compression of the waste to a comparatively high density bale which is then bound together. It has some advantages in the operation of a landfill site, but its principal application may be to reduce the cost of transportation, particularly if rail haul can be utilized. However, neither of these methods eliminate the necessity for careful location of the site to minimize the problem of leachate entering ground or surface water.

One possible major hazard has not yet been touched upon, and must be given very careful consideration whether pre-treatment is used or not. During the decomposition of the organic material in garbage a number of gases are generated, the most significant of these being carbon dioxide and methane. Since decomposition continues in the landfill site for many years, gas continues to be generated over that period.

Carbon dioxide is principally of concern, if it enters the watertable, by dissolving minerals which may degrade water quality. In one instance, due to probably unique circumstances, carbon dioxide entering basements of houses adjacent to a landfill site have caused a serious health hazard, but it is most unlikely that this incident will be repeated.

Methane is of greater importance primarily because of its combustibility, and since an explosive mixture can be formed with air. Strict control should therefore be exercised over the uses to which a disused landfill site can be put, and The Environmental Protection Act of Ontario provides this control for a period of twenty five years. Precautions can be taken to eliminate the hazard of gas entering buildings constructed on landfill sites, but great care is required, extensive engineering works may be necessary; and certainly single family residential development should not be permitted under any circumstances. Preferably, completed landfill sites should be developed as park or recreation areas.

Two points should be emphasized. First, a properly located and operated landfill site will virtually eliminate both health hazards and contamination of the environment. Second, disposal onto land must ultimately be utilized for some proportion of the total waste, irrespective of how the waste is treated, whether by incineration, reclamation, or any other methods that may become available in the near future.

I need not dwell on the air pollution resulting from the incineration of municipal waste. The emission of contaminants can be very substantially reduced by suitable incinerator controls, but it is important to recognize the limitations, and the consequences of

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implementing them. For example, an electrostatic precipitator will remove a very high proportion of the particulate matter, scrubbers must be installed to remove sulphur dioxide and other chemical systems to remove other gases, at extremely high relative cost. Moreover, to a large degree, all that is being achieved by such measures is to change the air effluents back to the solid state, converting them once again to water and land pollutants, though usually in a more stabilized form which may make them easier to handle.

The cost of such controls can be reduced if it is practicable to utilize the heat developed either to produce steam for district heating, or electricity. However, very substantial problems are involved, and it appears at present unlikely that any such approaches will be found practicable in North America except in specific limited circumstances, for example to serve a large compact high density development, possibly in association with improved handling methods for the refuse such as vacuum collection, or in association with industrial development utilizing steam.

Grinding prior to incineration may result in a number of advantages, though these remain to be proven during the operation of the SWARU facility in Hamilton. Storage and handling of the ground material is much simpler, and the Hamilton incinerator has been designed on the basis of a very short grate on the assumption that the bulk of the ground material will burn in the air before falling through the grate. In theory, it should result in improved combustion and a more stabilized ash.

The pit incinerator is a relatively unsophisticated unit. Essentially it comprises a concrete pit in which the waste is burned with a certain degree of control over the emission of buring debris and particulate matter by the use of air blowers to set up a rotating current of air in the pit. The unit is screened with wire mesh and the newer units have remotely operated gates, but they are only suitable for use in areas remote from development and have a limited application to municipal waste.

It will be obvious from the above that it is not possible to make a general statement that incineration is better than landfill or vice versa, and in fact the same comment applies to any other method of treatment or disposal of waste, existing or proposed. The selection of the "right" method will be dependent on the circumstances of each individual case, taking into account all of the factors involved including the degree of air, water and land pollution, health hazards, sociological factors, and of course cost, not only in terms of dollars and cents, but including the use of resources and of energy, which in turn has a resource use and

pollution penalty.

One other basic technology for waste disposal should be mentioned at this point, although its use in North America is at present extremely limited. This is the composting of organic wastes, with which is usually associated to a greater or less degree the salvaging of some of the more readily reclaimable materials such as metals and glass.

Although composting has seen very limited use in North America, and at present only a few such units are in operation, the principal reason is the difficulty of finding markets for the material produced, which is essentially a soil conditioner with very little fertilizing value. However, it has been intensively investigated in Europe, and firm data is available on many public health implications.

Any organic material can be composted including sewage sludge, animal manures, and the organic portion of municipal wastes.

Windrow composting is carried out by piling the raw material (ground garbage, sewage sludge or manure with a filler of sawdust, ground corn cobs, etc.) additional liquid provided if necessary, and the heaps turned frequently to provide aeration. The operation takes between six to twelve weeks to provide a crude compost.

A small operation of this type using sewage sludge is being carried out successfully in Ontario, but it is doubtful if the process could be extended in this country to large scale operations.

Mechanical composters provide means of control of temperature, and the degree of aeration necessary to optimize the process, and ensure pathogen kill. A stabilized compost can be produced in about five days, and a number of types of proprietary equipment are available.

In either case, if municipal waste is composted, the product is of limited value even as a soil conditioner, unless further processing is carried out. To be sold commercially, it must be screened to remove inorganic material, dried and pelletized, and suitable fertilizers may be added.

The Ministry have recently provided a grant for research into a completely novel approach to composting, by breeding worms in organic wastes. The worms are packaged and sold, and it appears possible to produce a well stabilized compost.

Previous experience shows that large scale composting can be carried on as a commercial operation. The most promising approach is likely to be the preparation of crude compost and its use for landfilling to rehabilitate pits and quarries, mine tailing areas, and to provide humus cover where this is lacking. Even this use, however, is entirely dependent upon developments in bulk transportation, or subsidization of transport costs.

Whether windrow composting or mechanical composting is used, the public health implications hinge largely on one critical factor, the temperature to which the treated material is raised, and the duration of its exposure.

In any properly controlled process, the likelihood of survival of pathogens, or of fly larvae and eggs, appears to be remote. The same comment may apply to many resistent forms of parasites, though some doubt exists as to whether it is also applicable to pathogenic fungi.

These comments apply essentially to the finished product; some aspects of the plant operation and the process effluents require close examination. Obviously, the sources of the waste require careful investigation to determine accurately the composition of the material being handled, and the process operation carefully checked to determine the mode of dispersal of contaminants in the surrounding environment. For example, hazardous industrial wastes should obviously be excluded, and care must be exercised in accepting institutional wastes such as pathological waste from hospitals. Greater care would need to be exercised if undigested sewage sludge was to be composted with the organic municipal waste, or if a concentration of pesticides and herbicides was anticipated.

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If manual separation of reclaimable material forms part of the process, obviously very careful controls are necessary to safeguard the health of workers. Hand picking of garbage does not appear to be a desirable approach, except on a small scale pilot plant.

Reclamation is, essentially, the separation of the waste into individual components, which after a greater or lesser degree of processing can be reused.

Some materials may be separated at source (by the householder, for example), but this also requires separate collection of the materials, the cost of which may counterbalance any benefits. The project funded by the Branch in Burlington, and future studies arising from it, should provide the necessary information to properly assess this aspect.

Reclamation at its simplest, most economic and most efficient, is exemplified by the re-usable container. Unfortunately, this concept is diametrically opposed to the aims of the container manufacturers, and to some degree, to the wishes of the consumer.

Another possibility that warrants investigation is the use of garburators in residences and commercial establishments. By this means, the organic portion of the waste is automatically segregated and discharged through sanitary sewers to sewage treatment plants. However, both the sewers and the treatment plants will have to be designed to take the very substantial increase in solids loading.

While the technology for materials segregation is advanced, its application to municipal waste is very much in the developmental stage. Municipal waste is an extremely

heterogeneous and variable material, whose composition and moisture content changes from day to day. Moreover, collection by packer truck, necessary to reduce transportation costs, compounds the problem by compressing the different elements of the waste together.

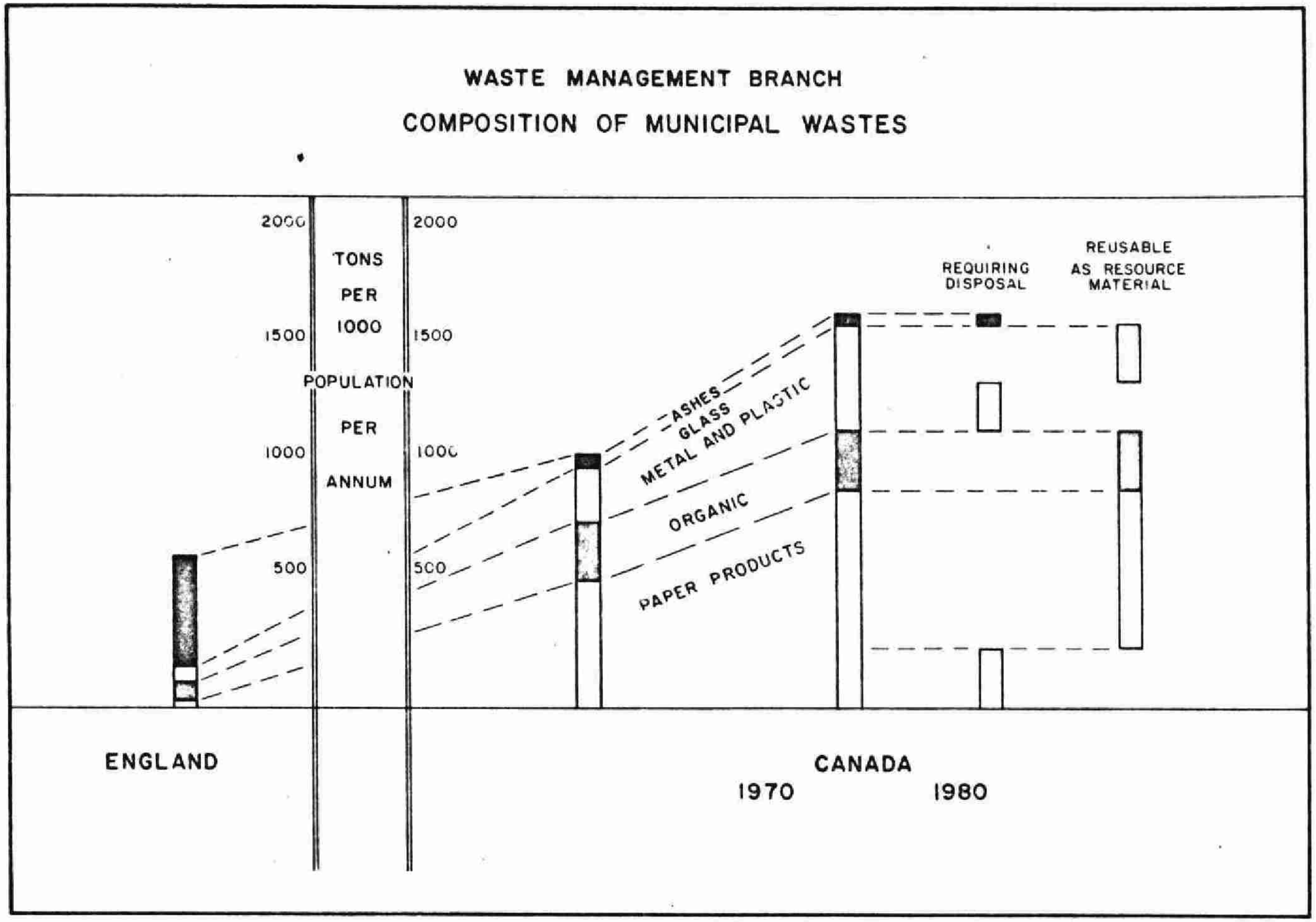
The major classifications of the materials separated will be:

1. paper and paper products;
2. ferrous metals;
3. non-ferrous metals;
4. plain glass;
5. coloured glass;
6. organic material;
7. some proportion that cannot be reused and must be disposed of including plastics.

Physically, three types of system are possible.

1. the simplest system will rely heavily on hand picking of the refuse to remove paper, cardboard, non-ferrous metals, and possibly glass;
   The plant proposed by Clark and Brown at Kingston is of this type.
2. a fully mechanized plant which does not depend on hand sorting;
   In this case, the material would probably be rough ground, and separation would be carried out first by dry methods such as air classification, screening, or ballistic separators, with, at a later stage, wet separation to a limited degree.
3. An exclusively wet separation system such as the fibre-claim process, which is basically designed for the recovery of paper fibre.

Obviously, the selection of a process will depend to a large degree upon whether the home separation of wastes such as



WASTE MANAGEMENT BRANCH
COMPOSITION OF MUNICIPAL WASTES
2000
1500
1000
500
TONS
PER
1000
POPULATION
PER
ANNUM
2000
1500
1000
500
ASHES
GLASS
METAL AND PLASTIC
ORGANIC
PAPER PRODUCTS
REQUIRING DISPOSAL
REUSABLE AS RESOURCE MATERIAL
ENGLAND
CANADA
1970
1980

newsprint is part of the system. For example, this would appear to rule out the fibre-claim process. In our view, hand picking is an undesirable element except as a temporary expedient in a purely experimental operation.

After removal of all the material which can be readily separated and reused, the balance, which should contain a large proportion of organics, can be composted. Alternatively, it could be dealt with by one of the new processes described in the next section, if no outlet for the compost is available.

New Processes

1. Fluid Bed Incineration

This process involves incineration on a bed of sand "fluidized" by injecting air through the bottom of the bed. It has been used for industrial waste for some time, and has recently been developed specifically for use with sewage sludges. It is applicable where incineration of material of comparatively low combustibility and high moisture content is indicated.

Its use in relation to municipal waste will probably be limited to wet processes such as fibre-claim, where composting is not acceptable.

2. Pyrolysis

This is the destructive distillation of organic materials by high temperature decomposition in the absence of oxygen.

The products of this process include combustible gas, tars, and light oils. Some plants incorporating pyrolysis units are being designed, but the process is yet to be proven for municipal waste.

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3. Hydrolysis

This process incorporates the hydrolysis of cellulose to produce sugars which in turn can be fermented to provide alcohol. This method is even less advanced than the others discussed, and in view of the vast quantities of cheaper and more easily handled organic materials available for the production of alcohol, is unlikely to be of any value whatsoever.

4. Wet Oxidation

Wet oxidation involves the combination of oxygen with organic material in water under high pressure and temperature. It has been used for the disposal of sewage sludges (the Zimmerman process). It has the advantage that the degree of treatment can be controlled to provide a product ranging from a completely stabilized ash to a minimum degree of biological stabilization to simplify disposal, at reduced cost.

Unless the process can be developed for the recovery of organic chemicals, its application to municipal waste will probably be limited except in special circumstances.

None of these developments are at the stage where they can seriously be considered as an alternative to presently available methods of treatment or disposal for municipal wastes. Moreover, it cannot be repeated too frequently, that all wastes will require ultimate disposal into one of the sinks, air, land, or water, with resulting pollution problems and health hazards which must be carefully investigated. As an example, the reclamation of newsprint separated from municipal waste is commonly assumed to be associated with a de-inking process so that the fibre can be reused for the same purpose. Consideration of the practicability of such a process will include not only the

examination of cost, and effect on the forest industries and pulp and paper companies, but must take into account the water pollution which will inevitably result, the disposal of the solid wastes from the plant, and the energy requirement for the process, which itself has environmental implications.

It should also be emphasized that all of the practices described, except landfill, would be prohibitively expensive on a small scale operation. Only by concentrating the wastes from a large population at one disposal site will it be possible to give any consideration whatsoever to other processes. This implies a detailed study of the area, not only in relation to the municipal waste generated, but to other classifications of waste such as sewage sludge, agricultural, and industrial wastes. It also requires detailed examination of the methods of handling and transportation of waste since in terms of overall cost this element accounts for three to four times the cost of disposal

The second major classification of waste with which we are concerned is liquid industrial waste.

The bulk of the waste produced in this category has a limited degree of potential hazard, comparable to that resulting from municipal and industrial solid waste. However, since it is liquid, its disposal onto land is undesirable for two principal reasons.

First, the possibility of run-off to surface waters or percolation to sub-surface aquifers is very considerably increased, and consequently suitable areas for disposal are very limited. Secondly, it is undesirable to utilize a sanitary landfill site for its disposal except in very limited quantities, since it may result in serious operational problems. Moreover, sanitary landfills are normally designed deliberately to reduce the quantity of liquid which will percolate through the waste. An exception might be the use of a completed municipal waste disposal site with a substantial depth of waste and under-drainage which will collect leachate for treatment.

Major industrial plants are required to install treatment facilities for their own wastes, which are under the control of the Industrial Wastes Branch, but large volumes of waste cannot be dealt with in this way due to:

(a) lack of technology for treatment, for example, brine;
(b) unless large quantities of one particular waste are being produced, the cost of in-plant treatment may be uneconomical;
(c) even if in-plant treatment is provided, provision must be available to deal with liquid residues from this treatment and waste materials resulting from a breakdown in operations;

The best solution to this particular problem is the establishment of central treatment facilities which due to the economies of scale can provide the pollution control equipment necessary, but which would be exorbitantly expensive if provided by each individual industry producing the waste.

Such a plant will be available in the near future to serve the Toronto Centered Region. Three major treatment streams will normally be necessary; thermal decomposition; chemical and physical processing; and biological oxidation. The sludges resulting from the processing may be incinerated or landfilled as appropriate.

A plant of this type, since it incorporates the various treatment streams, can reasonably provide much more complete treatment and minimize environmental contamination.

A major problem arises from various processes which result in very large quantities of dilute soluble salts. A good example is the brine displaced from underground gas and other storage caverns. In areas where it is practicable, discharge into suitable underground formations by a deep well is a reasonable interim solution.

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However, this should only be permitted under strict controls, with adequate monitoring to ensure that there are no detrimental effects. Suitable underground formations are limited both in geographical extent, and in their capacity to receive waste. In fact, they represent a resource which should be conserved by requiring surface treatment of all practicable wastes.

Our classification of hazardous wastes is restricted to those where a direct and significant hazard of fire, explosion, poison, or radioactivity may result, though in some instances biological and ecological effects must be taken into consideration.

In comparison to the other wastes which I have been discussing, the quantities involved are usually very small, and practices can be considered for treatment and disposal which would be out of the question for general wastes.

A very simple method, which is suitable for small quantities of a variety of waste consists of sealing the material within a small container which in turn is placed in a larger container such as a forty five gallon drum and the annular space filled with concrete. The drum is then buried in a suitable location, usually in an impermeable clay soil. If treatment is not feasible, permanent containment is the only reasonable alternative at present. More sophisticated methods are available and in use, but the principle is well illustrated by the example.

Falling into this category would be some elements of institutional and hospital wastes. These would include waste pharmaceutical materials, such things as disposable hypodermic needles and syringes, and pathological waste.

Despite the substantial hazard which is undoubtedly associated with materials in this classification, there have been surprisingly few incidents resulting in injury. The producers of these wastes are usually well aware of the risks involved, and are sufficiently responsible to supervise the handling and disposal procedures and ensure that they are carried out with minimum hazard.

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A major concern of the Ministry at present is in the development of early warning systems so that full investigation can be made in advance of all potentially hazardous materials, and means developed for their safe handling and disposal. It is obviously undesirable to be forced into the position of having to make complex technical decisions without adequate supporting data and under, usually, intense public pressure. Examples are numerous: D.D.T. phosphates, cyclamates, mercury, PCB's, and a number of others may be looming on the horizon.

Our fourth major category of waste comprises mainly organic waste, agricultural waste and sewage sludge for example.

We are not concerned with the agricultural waste which is produced and disposed of as part of normal farm operations.

We are becoming more and more concerned with the pollution and public health problems resulting from production of vast quantities of manures from feed lots, piggeries, and confinement operations particularly for egg production. These are not, in fact, farms but factories, and should be treated in the same way as any other industry which abuses the environment.

Traditionally, waste in this category which is purely organic has been disposed of by spreading onto fields as a soil conditioner. In limited quantities, and providing common sense precautions are taken, this is of little concern. However, as the quantities involved increase and the area of land available for disposal decreases, major public health and environmental problems result.

Manures from these highly concentrated operations contain elements which if they are leached into ground or surface waters may consitute a localized concern for public health. The major problem results from the oxidation in the soil of organics to nitrogen compounds, high levels of which in water supplies may have direct public health implications, and certainly contributes to eutrophication of surface waters.

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While the manures also contain elements such as arsenic, manganese and zinc, the concentrations are very low and unlikely to result in a hazard to public health, though further investigation on possible build up in the soil, and uptake by crops, is necessary.

Associated generally with agricultural operations, but which is normally associated with the previous category of wastes, are herbicides and pesticides. Greater attention should certainly be paid not only to the use but to the disposal of these materials and of empty containers.

Digested sewage sludge poses a very limited hazard, providing the sewage plant operation is carefully controlled. Local problems, however, may arise particularly if the sewage treatment plant deals with disproportionately large volumes of industrial waste.

There is no question that these wastes should be returned to the land. An Interdepartmental Committee which is studying the problem in connection with the phosphate removal program being introduced at sewage treatment plants has issued interim guidelines on the use of processed organic waste as a soil conditioner. It is anticipated that the strict controls provided will be incorporated as a regulation under the jurisdiction of the Waste Management Branch.

I need not dwell on the remaining two categories, abandoned vehicles and litter. They have very limited health or pollution implications; broken glass in litter, particularly on beaches, is obviously dangerous, particularly to children, and the snap-off rings on cans with aluminum tops have sharp edges which may also result in cut

feet. Action has been initiated this year to determine accurately the extent of both problems, before developing programs to cope with them.

There is no question that any waste management problem becomes a very highly charged emotional issue to members of the public involved. Noise, odours, increased traffic, the alleged reduction of property values resulting from waste disposal operations, littering, and similar factors undoubtedly add substantially to the other stresses of modern living. While they are not subject to quantitative analysis, nevertheless these qualitative considerations may exert a profound effect on the technology which can be utilized, on land use, upon the methods and costs of waste collection and certainly must be taken into consideration in any complete system planning.

In our view, reuse, recycling and reclamation will provide the only rational ultimate solution to these problems of waste management, not primarily to conserve resources, although this will be a valuable bonus, but as the only foreseeable means of keeping within reasonable limits the cost to the public.

I have dealt with the problems. Now what is the Branch doing, and what does it propose as solutions to these problems.

Our goal can be stated as:

To provide the necessary direction and control over the production, handling and reuse or disposal of waste so as to minimize deleterious environmental effects, reduce cost to the public, and conserve natural resources.

Dealing with the same waste classifications which I have just discussed, I will outline very briefly our principal objectives in dealing with each.

<u>Municipal and Industrial Solid Waste</u>

At present, more than 90% of the total is disposed of by landfill; generally, each individual municipality owns and operates a disposal site or sites to serve only its own waste; many of such sites were, until recently, dumps resulting in pollution and health hazards; and most waste management activities have been completely unplanned, and established and operated without regard to social or environmental offence.

The objectives of this activity are:

1. to ensure that all new waste management sites and systems are located or established, and operated to the required minimum standards
2. to ensure that all existing sites and systems are upgraded to the required minimum standards

It is recognized that these objectives cannot be achieved by the present haphazard practices without imposing intolerable cost. This cost can only be reduced to an acceptable level by advance planning for complete waste management systems throughout a geographical area without regard for political boundaries. For this reason, an essential part of this activity is the promotion of area planning by the provision of Provincial grants for the purpose.

Apart from the above, only be reducing the number of individual operations and thus attaining the benefits and the economies of "scale", can new and improved methods of operation be introduced. It is extremely unlikely, for example, that reclamation plants will be viable except as very large scale operations.

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The next objective of this activity can, therefore be stated as:

3. to reduce the number of inefficient individual operations and thus enable improved operating standards to be implemented economically.

It is estimated that the average cost of collection and disposal of municipal and industrial solid waste in Ontario at present is between 8 and 10 dollars per capita per annum. If standards were rigidly enforced, waste produced continues to increase, and no change in the present methods of collection and disposal are introduced, it is estimated that by 1980 these costs would be at least 25 dollars per capita, and possibly considerably higher. Apart altogether from any question of conservation of resources, every avenue which offers means of reducing the quantity of waste produced and reusing waste materials, must be explored.

There are six basic approaches:

1) Reduction in the quantity of material produced which is likely to result in waste. This could take the form of a voluntary reduction in packaging materials used by the industry, or Government action, such as the recent prohibition of disposable plastic milk containers.
2) Changes in the types of materials used to simplify separation, recycling, or reclamation of waste produced. Examples of this approach would be the encouragement of standard reusable containers, or the use of tin-free steel cans.
3) Separation at source. A research program to determine the feasibility and limits of this approach is now under way.
4) Processing facilities for separated materials. For example, if it is found feasible to separate newsprint at the home, it will be necessary to set up a newsprint de-inking plant.
5) Central reclamation plants.
6) Encouragement of the use of reclaimed material.

The Minster of the Enviroment has set up a Solid Waste Task Force specifically to examine the various possible strategies which can be employed in utilizing these approaches.

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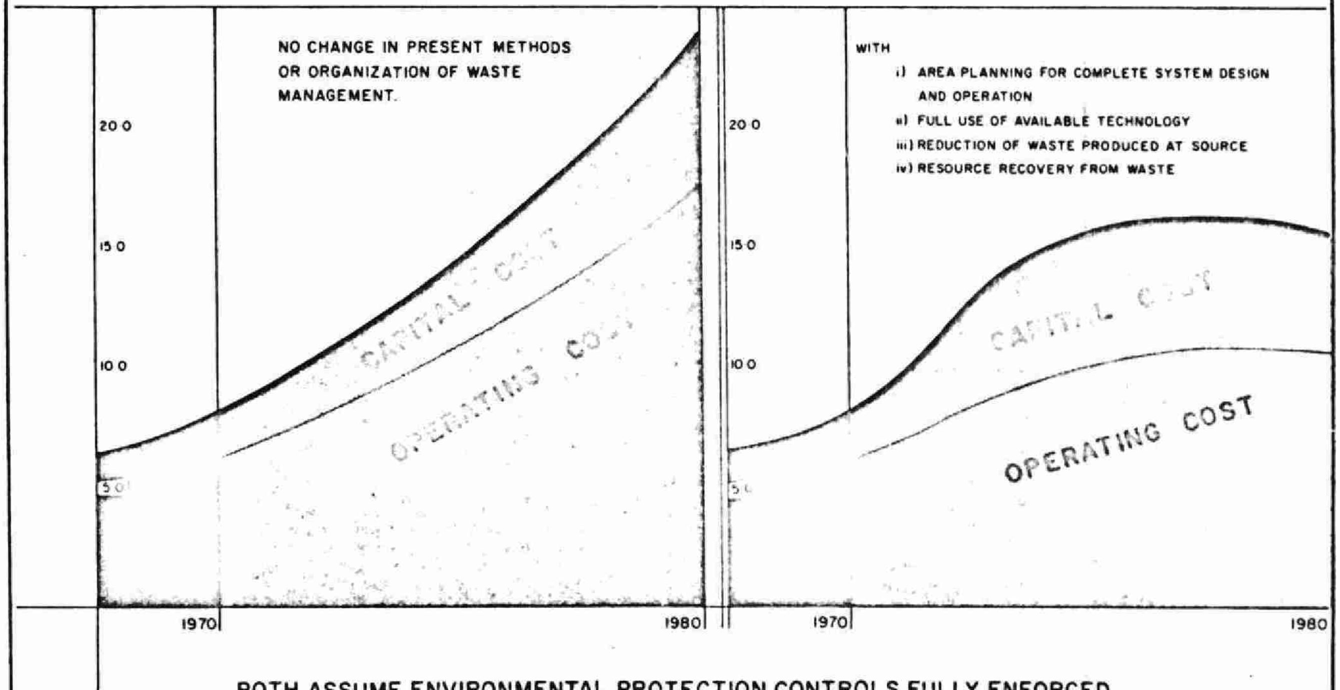
WASTE MANAGEMENT BRANCH

COST / CAPITA / ANNUM FOR COLLECTION AND DISPOSAL OF MUNICIPAL AND INDUSTRIAL WASTE



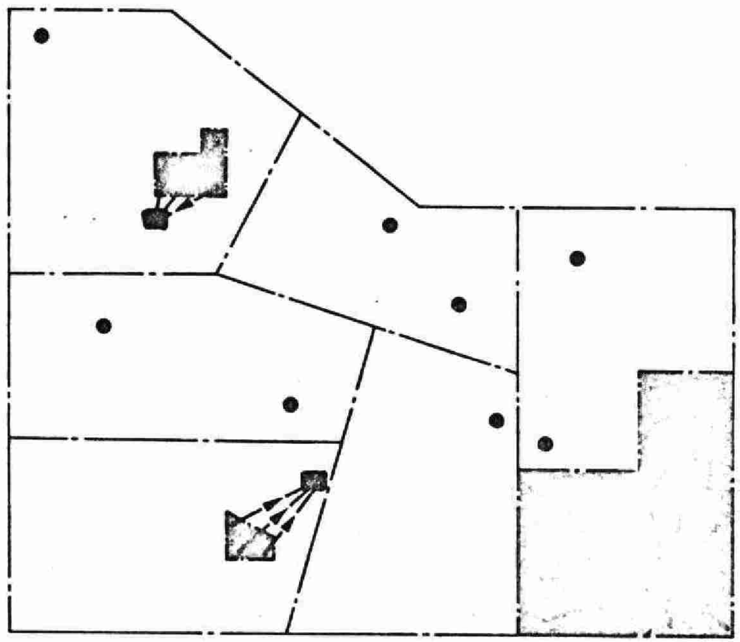
BOTH ASSUME ENVIRONMENTAL PROTECTION CONTROLS FULLY ENFORCED

WASTE MANAGEMENT BRANCH

TYPICAL URBAN / RURAL AREA

EXISTING WASTE

MANAGEMENT SYSTEMS



INCINERATOR

DUMP

LANDFILL

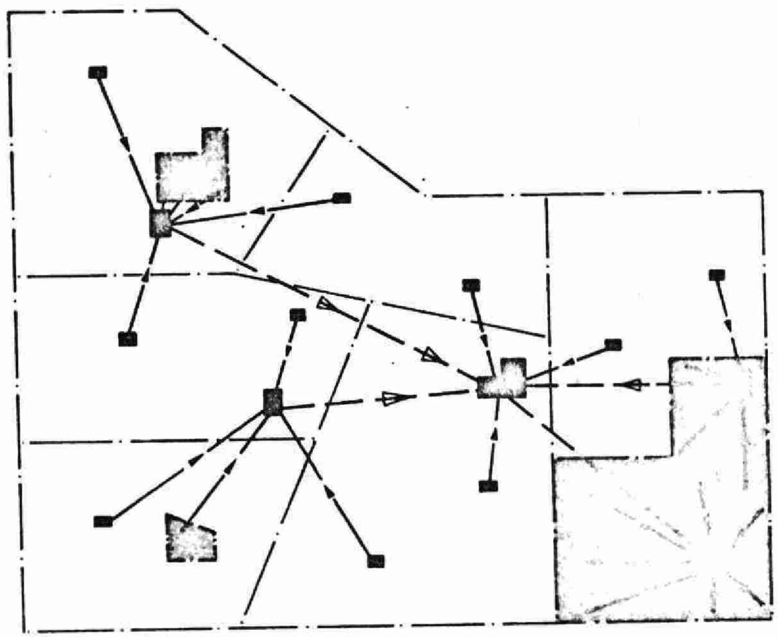
COLLECTION VEHICLE ROUTES

1. NO COLLECTION SERVICE IN RURAL AREAS.
2. NO CO-OPERATION BETWEEN MUNICIPALITIES.
3. DUPLICATION OF EFFORT AND INCREASED COSTS.
4. DUMPS LOCATED ANYWHERE CHEAP LAND CAN BE ACQUIRED.
5. LARGE NUMBER OF SMALL UNACCEPTABLE SITES.

WASTE MANAGEMENT BRANCH

TYPICAL URBAN / RURAL AREA

FUTURE WASTE MANAGEMENT SYSTEM



TREATMENT FACILITY

TRANSFER STATION

BULK CONTAINER

COLLECTION VEHICLE ROUTES

TRANSFER VEHICLE ROUTES

1 - RURAL AREAS SERVED BY BULK CONTAINER.

2 - TRANSFER STATIONS MAY INCLUDE BULK REDUCTION FACILITIES.

3 - TREATMENT FACILITY MAY INCORPORATE INCINERATION AND DISTRICT HEATING, RECLAMATION OR COMPOSTING, AND MAY INCLUDE TREATMENT OF INSTITUTIONAL WASTE AND SEWAGE SLUDGE.

4 - COST REDUCED BY -

(a) CONTAINERS IN RURAL AREAS.

(b) MECHANIZED COLLECTION IN RURAL AREAS.

(c) EFFICIENT LONG-HAUL TRANSPORTATION.

(d) ECONOMICS OF SCALE.

(e) AREA PLANNING AND COMPLETE SYSTEM DESIGN AND OPERATION.

WASTE MANAGEMENT BRANCH

MUNICIPAL AND INDUSTRIAL SOLID WASTE

DISPOSAL METHOD	YEAR	QUANTITY	NUMBER OF SITES
DUMP	1970	3.3 MILLION TONS	4,000
	1980	0.05 MILLION TONS	1,000
LANDFILL	1970	4.5 MILLION TONS	500
	1980	6.5 MILLION TONS	1,500
BULK REDUCTION (INCLUDING INCINERATION)	1970	1 MILLION TONS	20
	1980	4.7 MILLION TONS	60
RECLAMATION	1970	NIL	NIL
	1980	2.5 MILLION TONS	3
TOTAL	1970	8 MILLION TONS	
	1980	12 MILLION TONS	

4. to reduce cost and conserve natural resources by promoting the reduction of waste-producing developments, packaging material more suitable for reuse, recycling or reclamation; and systems for the reclamation of waste

Hauled Liquid Industrial Waste

This category includes all types of liquid industrial waste.

The objectives of this activity are:

1. to ensure that treatment facilities are provided for all wastes where technologically possible

It is hoped that this can be accomplished with the co-operation of industry by the encouragement of private operators. Such an operation should be economically viable in the major industrial centers such as Metro Toronto without financial support from Government. Whether similar facilities can be established elsewhere on the same basis will be dependent on the success of this operation and other factors which cannot be fully evaluated at present.

2. to ensure that the haulage of liquid industrial waste is carried out to the required minimum standards

3. to ensure that underground resources are conserved; underground formations of possible economic value are not impaired; and that no detrimental environmental effects result from the deep well disposal of liquid industrial waste

The underground resource represented by deep well disposal is limited, and must be conserved as far as possible to deal with wastes such as brine for which no economic treatment method is available, and for other material being produced now or in the future for which a disposal method must be available while the technology for treatment is being developed and implemented. Due to the very great concern of the public for the safety of well water supplies, and the need for municipal co-operation in carrying out approved Government programs, it is essential that a much greater factor of safety be considered in this case than might generally be thought necessary. For this reason, the policy has been accepted that wells into the Detroit River formation, which is less than 1,000 feet deep, should be closed as soon as possible to all materials except brine, and the industries and deep well operators encouraged to develop wells into the very much deeper, and therefore safer, Cambrian formation.

These objectives will be achieved through the establishment of treatment facilities by individual industries; the establishment of central treatment facilities; and the establishment of wells into the Cambrian formation;

<u>Hazardous Waste</u>

Disposal practices at present are haphazard and unsatisfactory. Two major problems can be recognized.

1. The difficulty in implementing orderly disposal practices without improvement to the management practices of the institutions generating them, for example, by properly controlled administrative practices for the separation of such wastes, their pre-treatment if necessary, and their safe storage pending collection.

WASTE MANAGEMENT BRANCH

LIQUID INDUSTRIAL AND HAZARDOUS WASTE

DISPOSAL METHOD	YEAR	QUANTITY	NUMBER OF SITES
LANDFILL	1970	140 MILLION GALLONS (LIQUID); ¼ MILLION TONS (SOLID)	UNKNOWN
	1980	70 MILLION GALLONS (LIQUID); 1 MILLION TONS (SOLID)	4
DEEP WELL	1970	160 MILLION GALLONS LIQUID	19
	1980	30 MILLION GALLONS LIQUID	3
COMPREHENSIVE TREATMENT	1970	NIL	NIL
	1980	100 MILLION GALLONS (LIQUID); 2 MILLION TONS (SOLID)	8
TOTAL	1970	300 MILLION GALLONS (LIQUID); ½ MILLION TONS (SOLID)	
	1980	200 MILLION GALLONS (LIQUID); 2 MILLION TONS (SOLID)	

2. The comparatively small quantities involved, which makes adequate treatment and disposal relatively expensive. However, this may also simplify transportation to a few central treatment facilities, providing improved methods of handling can be developed.

The objectives of this activity, therefore, are:

1. to encourage the establishment of central treatment facilities for the disposal of hazardous waste

It is hoped that these facilities can be made available by joint co-operative effort of the various institutions, with Government intervention limited possibly to assistance in the selection and approval of suitable sites. For example, the University of Toronto has expressed interest in establishing such a facility, and a committee set up for the purpose is at present examining the best method of handling and disposal for pathological wastes generated in the Metropolitan Toronto area.

2. to ensure that the handling, transportation, treatment and disposal of hazardous waste is carried out to the required minimum standards
3. to promote the improvement of management practices by industry and institutions to reduce the quantity and hazard of such wastes at the source
4. to assist in the development and improvement of procedures in the case of accident or emergency requiring transport and disposal of contaminating and hazardous material

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WASTE MANAGEMENT BRANCH

AGRICULTURAL WASTE AND SEWAGE SLUDGE

DISPOSAL METHOD	YEAR	QUANTITY	NUMBER OF SITES
ON LAND WITHOUT TREATMENT	1970	7 MILLION TONS	UNKNOWN
	1980	5 MILLION TONS	UNKNOWN
ON LAND AFTER STABILISATION	1970	3 MILLION TONS	UNKNOWN
	1980	10 MILLION TONS	UNKNOWN
ON LAND AFTER COMPOSTING	1970	(ABOUT 10,000 TONS))	2
	1980	4 MILLION TONS	7
TOTAL	1970	10 MILLION TONS	
	1980	MORE THAN 25 MILLION TONS	

Agricultural Waste and Sewage Sludge

Agricultural waste is at present exempted from the Regulations, and the problems of sewage sludge are now being examined by a Ministry Task Force, in view of the new phosphate removal programs being introduced.

Abandoned Automobiles

This is almost exclusively an aesthetic problem, though since all of the steel and some of the other materials involved can be reclaimed, it represents a substantial conservation of resources.

The two major problems in dealing with the backlog of abandoned vehicles, and their continuing clean-up, are:

1. the need to collect a number of vehicles at a suitable location to facilitate their transportation to a reclamation centre and
2. the cost of transportation from the remoter areas

When the price of scrap steel is high, as it has been recently, private operators can afford to collect all abandoned vehicles within a reasonable distance of the reclamation centers, and this in fact has already been done in some areas of Southern Ontario.

At greater distances, providing sufficient cars can be collected in one spot, it may still be economic for the private operator to prepare with a portable crusher and transport in bulk to the reclamation center. It is not entirely clear at present just what distance limits may be involved, and these in any event will obviously vary with the rise and fall in the price of scrap steel.

The principal objective of the Branch in 1972/73 will be to carry out clean-up campaigns, surveys, and studies in selected areas to determine the most efficient and economic use

of Government resources to achieve the long term objectives.

These are:

1. to ensure that collection centers, transportation equipment and reclamation plants for abandoned vehicles are operated to the required minimum standards
2. to promote the establishment of collection centers for abandoned vehicles throughout Ontario
3. to promote the establishment of systems for collection, transportation and reclamation of abandoned vehicles to ensure their immediate recovery.

Litter

As in the case of abandoned automobiles, this is primarily an aesthetic problem, though a significant health hazard results from broken glass in litter, and the encouragement of container re-use may form a part of the solution.

Littering control program developed has three separate aspects,

1. educational, public relations and clean-up campaigns
2. adequate numbers of approved types of litter receptacles to be provided.
3. control of beverage containers.

It should be noted that litter consists almost entirely of packaging materials, and containers form the most objectionable elements, so that special efforts may be justified to reduce their appearance in litter.

The long term aims of this activity are:

1. to promote the development and use of packaging materials and practices which will minimize the litter problem.

One further Branch activity should be mentioned----

Planning and Special Projects

This is essentially a support program to provide data which can be utilized for the improvement of waste management practices, and the continued development of standards.

While the Branch will provide in-put to other departmental planning functions, they are not included in the following evaluation.

1. To make available information to municipalities, industries, private operators, other Government agencies and the public on waste management practices and costs in Ontario by the establishment of a data collection, storage and retrieval system.
2. To promote the utilization of new and improved technologies by carrying out the necessary research and development programs.